

Inventions & Innovation Project Abstract

Carbon Dioxide Nanoelectric Sensors

Carbon Dioxide concentration is a dynamic measure of indoor air quality. The cost of heating and air conditioning buildings can be reduced significantly by active control schemes that use carbon dioxide measurement to regulate makeup airflow. Nanomix is developing a nanoelectronic carbon dioxide sensor based on carbon nanotube transducers fabricated on a silicon chip. Each device contains an array of nanosensors that are coded to respond to carbon dioxide molecules. The resulting nanosensor chip features state-of-the-art performance in a tiny package that consumes very little power. Nanosensors can replace the costly infrared sensors used in today's demand-controlled ventilation applications. The project offers an opportunity for the U.S. to pioneer a breakthrough in nanoelectronics and to apply the technology to reduce energy consumption and improve indoor air quality.

The primary market for CO₂ sensors in Demand Controlled Ventilation (DCV) systems in the U.S. is the 1.5 million buildings having more than 10 occupants. The target market includes all ventilated spaces that must meet the ventilation percentages set forth by ASHRAE 62.99. Major end users include buildings used for education, offices, healthcare, and lodging. There is a huge potential for energy savings in U.S. buildings. The \$290 billion spent annually to heat and air condition buildings accounts for two-thirds of the nation's electricity usage and one-third of the total energy usage. DCV systems can lower total energy use and reduce peak energy demand by eliminating unnecessary over ventilation, while ensuring the target airflow per occupant rates are met at all times. Estimated energy savings ranges from 5-80% of the total heating and air conditioning cost, depending on the application, but is generally between 10-30%.

The primary economic benefit associated with the technology lies in the energy savings that would result from a faster pace of adoption of CO₂ driven DCV systems. This could ultimately represent a reduction of U.S. electricity usage measured in billions of dollars. The environmental benefit of improved CO₂ sensors for DCV systems has two facets; a reduction in total electricity consumption and improved indoor air quality. Reduced electricity consumption on the order of 10% or more per building could be expected if DCV were adopted on a widespread basis.



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